Proportion Extension Problems

Direct Proportion Past

1. A bag of 5 apples costs £1.20. What is the cost of 40% more apples? How many apples is that?

2. If 10% of a number is 15, what is 40% of the number?

3. A shop offers a 15% discount for buying 3 of the same item. If one book normally costs £8, how much would 3 books cost with the discount?

4. The cost of fuel is directly proportional to the number of litres purchased. If 40 litres cost £68.00, and the price then increases by 5%, what will 25 litres cost at the new price?

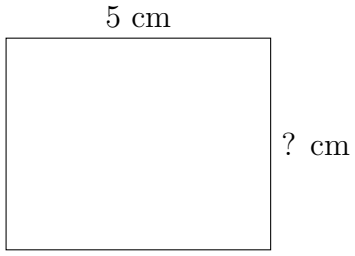
5. A coffee shop's revenue is directly proportional to the number of customers. On Monday, they had 120 customers and made £420. On Tuesday, they increased their prices by 8%. How many customers did they have on Tuesday if their revenue was £453.60?

Direct Proportion Future

Instructions: Solve the following problems involving the perimeter and area of 2D shapes. The shapes are similar unless stated otherwise.

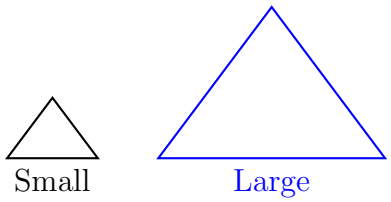
6. The perimeter of a square is directly proportional to the length of its side. If a square with a side of 4 cm has a perimeter of 16 cm, what is the perimeter of a square with a side of 11 cm?

7. The length and width of a rectangle are in a direct proportion. A rectangle has a length of 5 cm and a perimeter of 18 cm. What is the perimeter of a rectangle with a length of 15 cm?



8. The area of a square is directly proportional to the square of its side length. If a square with a side of 3 cm has an area of 9 cm^2, what is the area of a square with a side of 7 cm?

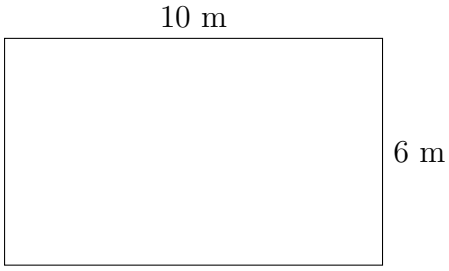
9. Two similar triangles are shown below. The perimeter of the smaller triangle is 21 cm. The side lengths of the larger triangle are 2.5 times those of the smaller one. What is the perimeter of the larger triangle?



10. A rectangular garden is 10 m long and 6 m wide. A new, similarly shaped garden is to be built. The area of the new garden needs to be 50% larger than the original.

    (a) What is the area of the new garden?

    (b) What is the perimeter of the new garden?



Original Garden

Rates of Change Past

11. A plant was 20 cm tall. Over the next week, it grew by **5%**. At what speed did it grow, in cm per day?

12. A bathtub fills at a rate of $8\,\mathrm{L\,min^{-1}}$. The plug is slightly loose, and water drains out at a rate that is 2% of the fill rate. If the tub starts empty, how much water is in it after 10 minutes?

13. A car's value was £15,000. It depreciates (loses value) at a rate of 12% per year. A motorbike's value was £8,000 and it depreciates at 8% per year. After 3 years, which vehicle is worth more? Justify your answer with calculations.

14. A social media post is shared rapidly. On the first day, it gets 200 shares. The number of shares increases by 15% each day after that.

    (a) How many shares does it get on the third day?

    (b) What is the total number of shares at the end of the third day?

15. A factory's energy costs are £10,000 per month. The manager invests in new equipment which is 20% more efficient. However, due to increased production, the factory now runs for 15% more hours each month, up from 200 hours. Calculate the new energy cost per hour, and per month, assuming cost is directly proportional to running hours.

Rates of Change Future

16. A square has a side length that is increasing at a rate of $2\,\text{cm}\,\text{s}^{-1}$. What is the rate of change of its perimeter when the side length is 5 cm?, what about when the side length is 10 cm? Does the rate depend on the side length?

17. A rectangular car park is 60 m long and 40 m wide. It is to be resurfaced. The cost of resurfacing is £15 per square metre. Calculate the total cost.

18. A circular oil spill is spreading. It starts with a radius of 1m. The radius of the spill is increasing at a constant rate of $0.5\,\text{m}\,\text{min}^{-1}$.

    (a) Calculate the rate at which the **circumference** of the spill is increasing when the radius is 4 m. (Use $C = \pi D$)

    (b) Calculate the rate at which the **circumference** of the spill is increasing when the radius is 8 m.

    (c) Find the area of the spill after 10 minutes. (Use $A = \pi r^2$)

19. A gardener is planting a rectangular flower bed. The length of the bed is increasing at a rate of $1\,\text{m}\,\text{h}^{-1}$ and the width is increasing at a rate of $0.5\,\text{m}\,\text{h}^{-1}$. At a specific moment, the length is 6 m and the width is 4 m.

    (a) At what rate is the **perimeter** increasing at this moment?

    (b) How much will the **area** have increased by 30 minutes later? Do you think it grew at a constant rate?

20. A decorative path is being built around a rectangular pond. The pond is 10 m long and 6 m wide. The path has a uniform width of x metres all the way around.

    (a) Show that the area of the path, A, is given by the formula $A = 4x^2 + 32x$.

    (b) If the path is being paved at a rate of $0.8\,\text{m}^2\,\text{min}^{-1}$, how wide is the path after 20 minutes, assuming it is being paved outwards from the rectangle?